

Fans at the surface ends of the exhaust shafts would provide the moving force for the subsurface repository airflow. The fans would have enough power to exhaust the maximum amount of air required during the emplacement, monitoring, and closure periods. The volume of air moved by the fans would be adjustable to meet cooling requirements as they varied over time. The fans would draw air through the exhaust mains at a rate that ensured that air would always flow into the emplacement drifts from the main drifts, never allowing air to recirculate back to the main drifts.

Ventilation under the higher-temperature repository operating mode would remove at least 70 percent of the heat generated by the waste inventory during the preclosure period (DIRS 153849-DOE 2001, Section 2.1.2.2). The peak ventilation air temperature of 58°C (about 136°F) for a 1.4-kilowatt-per-meter linear thermal load would occur about 10 years into the preclosure period and would decrease thereafter (DIRS 150941-CRWMS M&O 2000, pp. 4-24 to 4-25). This temperature is lower than the exhaust air temperature of many industrial processes, such as powerplants and manufacturing facilities. The peak ventilation air temperature under the lower-temperature repository operating mode would be lower than that described above.

Ventilation requirements for emplacement drifts would vary according to the activities conducted in those drifts. Prior to emplacement, ventilation would provide fresh air and control dust levels to ensure an acceptable environment for construction personnel. During emplacement, ventilation would maintain drift temperatures within an acceptable range for equipment operation.

While DOE was conducting concurrent development and emplacement operations, it would maintain two separate ventilation systems, one for each operational area (development and emplacement). This separation would be accomplished by placing airlocks in the main drifts to ensure physical separation of the air space between the two areas. On the development side, the ventilation system would work under positive pressure, with air forced in through the development intake shaft or the South Ramp through a duct and exhausted through the South Ramp. On the emplacement side, the required ventilation facilities for the commissioned emplacement drifts would be available and operational in their final configuration; the ventilation system would work under negative pressure by drawing air out through the exhaust main (through the exhaust or “hot” side of the exhaust main), and from there through the exhaust shafts.

#### **2.1.2.2.3 Waste Package Emplacement Operations**

DOE would transport both the waste package and metal emplacement pallet as an integral unit from the Waste Handling Building to the prepared *ground support* in the emplacement drift. The transport of each waste package to the subsurface would start after the loading of a waste package and its emplacement pallet on a bedplate (railcar) transporter in the Waste Handling Building and then into the shielded section of the transporter. At its closed end the transporter would be coupled to a manned primary electric-powered locomotive (trolley). A manned secondary electric-powered locomotive would then be coupled to the transporter at the door end outside the Waste Handling Building (DIRS 153849-DOE 2001, Section 2.3.4.4.1). All waste packages would be transported by trolley underground through the North Ramp and into the emplacement area main drift. On arrival at the emplacement drift, the secondary locomotive would be uncoupled from the transporter, which would then be pushed into the emplacement drift turnout by the primary locomotive and stopped short of the isolation doors and loading dock. The operators would leave, and the locomotive operation would proceed by remote control. The isolation doors would be opened remotely, as would the transporter doors. Under remote control, the primary locomotive would push the waste package transporter into the off-loading dock. The waste package and pallet, seated on the bedplate, would be rolled out of the transporter, under remote control, to stop on the transfer section of the railcar. The remote-controlled gantry would straddle the waste package and pallet, lift the waste package and pallet from the bedplate, and carry them to the designated location in the emplacement drift. The bedplate would be rolled back into the waste package transporter, the transporter doors would be closed, and the transporter would be moved back to the access main drift using the

primary locomotive under remote control. The isolation doors in the turnout would be closed, allowing the locomotive operators to recouple the secondary locomotive to the railcar. The empty transporter would be returned to the Waste Handling Building to pick up the next waste package (DIRS 153849-DOE 2001, Section 2.3.4.4.1).

DOE has developed plans for waste package retrieval for normal and off-normal conditions. Waste package retrieval under normal conditions would use the same subsurface equipment and facilities as emplacement, but in reverse order. This would provide a built-in capability for retrieval that could be readily implemented. Individual waste package removal for inspection, testing, and maintenance reasons is not considered retrieval; however, waste package removal for these purposes, if needed, would involve the same equipment and operational steps. Alternative waste package retrieval equipment and processes have been identified for off-normal conditions when normal retrieval procedures could be difficult or impossible to execute. Additionally, support equipment (equipment to remove obstacles, prepare surfaces, or install temporary ground supports) that could be used in retrieval operations under off-normal conditions has been identified. The equipment and processes would support various scenarios such as repair of the riling system, repositioning the emplacement pallet and waste package, or cleaning or removal of debris. All retrieval scenarios include radiation and temperature controls and other administrative controls, as needed, to conduct a safe retrieval operation (see DIRS 153849-DOE 2001, Section 2.3.4.6).

#### **2.1.2.2.4 Engineered Barrier Design**

Engineered barriers would include those components in the emplacement drifts that would contribute to waste containment and isolation. The design includes the following components as engineered barriers: (1) waste package, (2) emplacement drift *invert*, (3) *drip shield*, and (4) to a lesser extent, ground support (DIRS 153849-DOE 2001, Section 2.4). The following sections describe the details of these components.

**2.1.2.2.4.1 Waste Package and Drip Shields.** The function of the waste package would change over time. During the operation and monitoring phase, the waste packages would function as the vessels for safely handling, emplacing and, if necessary, retrieving their contents. After closure, the waste packages would be the primary engineered barrier to inhibit the release of radioactive material to the environment. The waste package design consists of two closed concentric cylinders in which DOE would place the waste forms.

The waste package would have a corrosion-resistant Alloy-22 outer shell and a stainless-steel (Type 316NG) inner shell to provide structural support (DIRS 153849-DOE 2001, Section 3). Alloy-22 consists mostly of nickel, chromium (up to 22.5 percent), and molybdenum (up to 14.5 percent). Type 316NG stainless steel consists mostly of iron, chromium (up to 18 percent), nickel (up to 14 percent), and molybdenum (up to 3 percent) (DIRS 153849-DOE 2001, Section 3.4.1.1). In addition, the waste package would have a top lid design that consisted of three lids. The innermost lid would be stainless steel welded to the stainless-steel shell. The middle and outer lids would be Alloy-22, welded to the Alloy-22 outer shell (DIRS 153849-DOE 2001, Section 3) (see Figure 2-15). The highly corrosion-resistant Alloy-22 outer shell of the waste package would protect the underlying structural material from corrosive degradation, while the strong internal structural material would support the thinner corrosion-resistant material.

A drip shield with a nominal thickness of 1.5 centimeters (0.6 inch) of highly corrosion-resistant titanium would be placed over the waste package just before repository closure. The titanium drip shield and the Alloy-22 outer cylinder would provide two diverse engineered corrosion barriers to protect the waste from contact with water. The use of two distinctly different corrosion-resistant materials would reduce the *probability* that a single mechanism could cause the failure of both materials. Figure 2-16 shows a side view of a drip shield and an end view of the waste package and drip shield.